SVKM's
D. J. Sanghvi College of Engineering

Program: B.Tech (All Programs) **Academic Year: 2022** **Duration: 3 hours**
Date: 04.01.2023
Time: 10:30 am to 01:30 pm
Subject: Operations Research (Semester VII) **Marks: 75**

(1) All Questions are Compulsory.
(2) All questions carry equal marks.
(3) Answer to each new question is to be started on a fresh page.
(4) Figures in the brackets on the right indicate full marks.
(5) Assume suitable data wherever required, but justify it.
(6) Draw the neat labelled diagrams, wherever necessary.
(7) Random Numbers can be generated on calculator

Question No.		**Max. Marks**
Q1	i. Discuss the applications of various Operations Research Techniques	[05]
	ii. A firm produces three products. These products are processed on three different machines. The time required to manufacture one unit of each of the three products and the Daily capacity of the three machines are given in the table below:	[10]

Table:1

Machines	Time per unit (minutes)			Machine Capacity (Minutes/day)
	P1	P2	P3	
M1	2	3	2	440
M2	4	-	3	470
M3	2	5	-	430

It is required to determine the daily number of units to be manufactured for each product. The profit per unit for the product 1, 2 and 3 is Rs 4/-, Rs 3/- and Rs 6/- respectively. It is assumed that the amount produced is consumed in the market. Formulate the mathematical LP. model that will maximize the daily profit. & Solve it

Q2(a) i. A company has a team of four salesmen and there are four districts where company wants to start its business. After taking into account the capabilities of salesmen and the nature of districts the company estimates that the profit per day in rupees for each salesman in each district is given below: [08]

Salesmen	Districts 1	2	3	4
A	16	10	14	11
B	14	11	15	15
C	15	15	13	12
D	13	12	14	15

Find the assignment of salesmen to various districts which will yield maximum profit.

ii. Sunray Transportation Company ships truckloads of grain from three silos to four mills. The supply (in truckloads) and the demand also (in truckloads) together with unit transportation costs per truckload on the different routes are summarized in the transportation model in table. Find the initial basic feasible solution using Vogel Approximation Method. [07]

Table

		Mills				
		1	2	3	4	Supply
	1	10	2	20	11	15
Silo	2	12	7	9	20	25
	3	4	14	16	18	10
Demand		5	15	15	15	

OR

i. Workers come to tool store room to receive special tools (required by them) for accomplishing a particular project assigned to them. The average time between two arrivals is 60 seconds and the arrivals are assumed to be in Poisson distribution. The average service time (of tool room attendant) is 40 seconds. Determine [07]

1. Average queue length
2. Average length of non empty queue
3. Average number of workers in system
4. Mean waiting time of an arrival

ii. Solve the following problem on game theory using principle of dominance [08]

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

Simplex

Q3 (a) i. Solve the following L.P.P. by using ~~simple~~ method [12]

Minimize $Z = x_1 - 3x_2 + 3x_3$

Subject to $3x_1 - x_2 + 2x_3 \leq 7$

$2x_1 + 4x_2 \geq 12$

$-4x_1 + 3x_2 + 8x_3 \leq 10$

$x_1, x_2, x_3 \geq 0$

ii. State the need of Big M method for solving L.P. problem [03]

Q3 (b) **OR** [05]

i. Solve the following game

	B_1	B_2	B_3	B_4
A_1	8	-2	9	-3
A_2	6	5	6	8
A_3	-2	4	-9	5

ii. A firm has divided its marketing area into three zones. The amount of sales depends on the number of salesmen in each zone. The firm has been collecting the data regarding sales and salesmen in each area over the number of past years. [10]
The information is summarized in table Q4a .For the next year firm has only 9 salesmen and the problem is to be allocate these to the three different zones to that total sales are maximum.

Table Q3b:Profit in thousands of rupees

Number of Salesmen	Zone 1	Zone 2	Zone 3
0	30	35	42
1	45	45	54
2	60	52	60
3	70	64	70
4	79	72	82
5	90	82	95
6	98	93	102
7	105	98	110
8	100	100	110
9	90	100	110

Q4 i. A Bakery owner keeps stock of a popular brand of cake. Previous experience indicates the daily demand as given below: [08]

Daily Demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

Simulate the demand for the next 10 days. Find out the stock situation if the owner of the bakery decided to make 30 cakes every day. Also estimate the daily average demand for this cake on the basis of simulated data.

ii. The purchase price of machine is ₹ 52000. the installation charges amount to ₹14400.and its scrap value is only ₹ 6400.the maintenance cost in various years is given below: [07]

Year	1	2	3	4	5	6	7	8
Maintenance cost (₹)	1000	3000	4000	6000	8400	11600	16000	19200

After how many years should the machine be replaced? Assume the machine replacement can be done at the year ends.

Q5 **Solve any Three.**

i. State the characteristics of the queuing system . [05]

ii. Find the saddle point for the game having the following payoff table [05]

		Player 2			
		I	**II**	**III**	**IV**
Player 1	I	3	-3`	-2	-4
	II	-4	-2	-1	1
	III	1	-1	2	0

iii. On an average 6 customers reach every hour on a telephone booth to make calls. Determine the probability that exactly 4 customers will reach in 30 minutes period assuming that arrival follows Poisson distribution. [05]

iv. Explain the role of Bellman's principle of optimality in dynamic programming [05]